Glass ceiling and belief flipping : theory and evidence from Egypt

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Working paper

2015-02

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OFCE-PRESAGE

January 2015

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Abstract

This paper proposes a dynamic statistical-discrimination model of job assignment and promotion which takes into account the endogeneity of human-capital investment and where the employer's prior beliefs are self-fulfilling in equilibrium. The model shows that the equilibrium results from standard statistical-discrimination models may change when we account for discrimination/self-selection in hiring via the employer's beliefs about worker expected quit rates and ability. The model is estimated on the Egyptian labour market using a multivariate simulated maximum likelihood model, and the results confirm the model's predictions. When women face significant adversity in hiring, those women who overcome this initial discrimination are as likely to be promoted as their male counterparts with similar characteristics.

Key words: Efficient promotions, gender discrimination, prejudice.
JEL classification: J16, J71.

*I am specially grateful to Ragui Assaad, Bernard Fortin, Thierry Kamionka, Catherine Sofer and Michel Sollogoub for helpful comments and suggestions, which substantially improved the paper. I would like to thank also Andrew Clark, Dominique Meurs, Hélène Périvier and Robert Pollak.

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1 Introduction

There has been much empirical work on the male-female wage differential, finding that a considerable part of the gender wage gap can be explained by the fact that women are seriously under-represented at the level of the highest-paid jobs. It is notably very often argued that women are less likely to be promoted to senior job levels than are men.

Pekkarinen and Vartiainen (2006) show that blue-collar women in the Finnish metal industry have to meet higher productivity thresholds in order to be assigned to more complex jobs. Using data from the US National Longitudinal Survey of Youth (NLSY) 1984 – 1989, Gjerde (2002) emphasises that, although women are less likely to be promoted to higher job levels than men, this negative relationship between promotion standards and gender is only observed in a few occupations. Gobillon et al. (2012), considering gender differences in access to jobs and using wages as a proxy for the rank of the position, find that female French executives have less access to high-paid than to low-paid jobs. In the UK labour market for academic economists, Blackaby et al. (2005) also find a significant gender gap in promotion opportunities. McDowell et al. (2001) and Ginther and Hayes (2003), who also focus on the academic labour market, come to similar conclusions.

The theoretical literature on unequal promotion opportunities has mostly relied on the difference in male and female attitudes to non-market work.[1] The model in Lazear and Rosen (1990) considers that women's higher expected value of time at home leads to less attachment to the labour market, so that the optimal and socially-efficient response is to require a higher ability threshold for female promotion.

Models of promotion inequality are generally static, where the employer cannot perfectly evaluate the worker's ability, but nonetheless observes some information that can be used to estimate ability. The employer's promotion decision is therefore determined at one point in time according to this perceived ability. What has been ignored in these models is that employers progressively learn more about worker ability over the career of the latter, and may then plausibly change their prior beliefs. Particularly, in the model of Lazear and Rosen (1990), the possibility that women are treated adversely during hiring is not taken into account. The employer is assumed to be gender-blind during hiring, and job assignment is therefore irrelevant. With this restriction on their model they cannot address any potential bias due to the selection of workers at hiring, and how this may later affect the employer's beliefs about workers who overcome this initial adversity.

We here contribute to the existing literature in two main ways. First, we propose a theoretical model of statistical discrimination in job assignment and promotion in a more realistic dynamic environment by accounting for potential discrimination against women in hiring. We show how the standard results from discrimination models change in such dynamic settings. Unlike other theoretical models, our approach here brings together the endogeneity of human-capital investment, non-market alternatives and hiring discrimination against women. Second, while existing empirical work has underlined the different quit rates of men and women to explain the observed gender promotion gap, to our knowledge, only Winter-Ebmer and Zweimuller (1997) have introduced an explicit measure of worker labour-force attachment. Our work here is the first to simultaneously consider selection into the labour force and endogenous human-capital investment and separation rates using a structural model.

The model is tested using the Egyptian Labour Market Survey (ELMS) for 2006, using a multivariate Maximum Simulated Likelihood (MSL) model of promotion. We then examine differences in hiring and promotion outcomes between men and women by applying a generalised residuals approach which extends the Oaxaca-Blinder decomposition (Oaxaca, 1973; Blinder, 1973). The inclusion of an explicit measure of worker labour-force attachment allows us to distinguish between differences in hiring and promotion opportunities due to efficient hiring/promotion and statistical discrimination.

The remainder of the paper proceeds as follows. The theoretical model is illustrated in Section 2, and the Egyptian labour market context is described in Section 3. Section 4 then presents the data and some elementary support for our theoretical model. The econometric model of hiring and promotion opportunities and the methodology used to analyse differentials in hiring and promotion outcomes appear in Section 5. We present our empirical results in Section 6. Last, Section 7 concludes.

2 Theoretical model

The model is to a certain extent related to the classic statistical-discrimination literature in that it relies on imperfect information about worker productivity. As in Phelps (1972), we assume that the employer only observes a noisy signal about the worker's ability, although noisier measures for the disadvantaged

[1] See Becker (1985); Bulow and Summers (1986); Lazear and Rosen (1990) for further theoretical discussion of the asymmetric allocation of men and women across occupations.

group are not required in our model for the group to be treated unequally. We consider, in line with Arrow (1973), that the employer's prior beliefs about each group are sufficient to produce an equilibrium in which groups are not treated equally. However, unlike these two models, the prior beliefs here do not directly refer to premarket investments in human capital; they rather pick up the employer's expectations of the separation probability, which, in turn, affect the worker's investment decisions.

We also propose a theory of statistical discrimination in job assignment and promotion, rather than in wages as in the standard statistical-discrimination model. We implicitly suppose that there are wage differentials between jobs, and that workers are paid identically within each job.

The model presented here extends the model of Lazear and Rosen (1990), being closer in spirit to Coate and Loury (1993) and Fryer (2007). Our first contribution, and a key difference between the model presented below and that of Lazear and Rosen (1990), is to account for the hiring stage. In particular, Lazear and Rosen assume that employers are gender blind at the hiring stage, so that men and women are treated equally in terms of the initial job assignment, although men receive preferential treatment at promotion. We, on the contrary, assume that selection occurs during hiring, and show how this can affect, under certain conditions, the main equilibrium results of Lazear and Rosen.

We also depart from Lazear and Rosen by explicitly introducing endogeneity in human-capital investment. We consider human-capital investment both prior to labour-market entry and after hiring, over the career. Although, Coate and Loury (1993) and Fryer (2007) consider the endogenous nature of worker productivity, the former takes place in a static environment, and both models ignore non-market alternatives and how expectations about labour-market separation might affect agents' decisions.

Our contribution is thus to develop a dynamic statistical-discrimination model including both the employer's optimal choices regarding hiring and promotion, and worker human-capital investment.

We will consider what happens when the employer does not face the same population before and after hiring, and how this may change agents' behaviours. In equilibrium, the employer's prior beliefs about separation probabilities, and hence worker ability, are self-fulfilling.

We now turn to the formal specification of the model. Consider an environment with two types of job and where advancement occurs over the career. We distinguish four time periods. The first is prior to labour-market entry, during which workers have to decide whether to invest in order to be assigned their desired job. We thus have two worker types: those who invest and become qualified for the job (type I_q), and those who do not invest and are thus unqualified for the job (type I_u). The second period commences after hiring. During this period workers face another investment decision, this time regarding promotion eligibility. We now have three categories of workers. The group initially qualified for the job (type I_q) who undertake the required promotion investment (I_{qq}). The workers who invested in the first period but do not invest for promotion remain as type I_q. The last category corresponds to the workers of type I_u who did not invest in the first period. As we will see below, these workers are not eligible for promotion regardless of their second-period investment decision. Knowing this, they do not invest in the second period and remain as type I_u. The third period corresponds to the promotion stage, in which workers may either be promoted to a more qualified job or remain in their initial job position. The final period begins after the promotion stage, during which the worker either quits or remains in the job.

The environment is characterised by imperfect information about worker ability. The employer does not perfectly observe prior to the hiring/promotion stages whether a worker is qualified for the job.[2] Nature assigns each worker an identity; male or female, and an investment cost at each stage. The employer observes a noisy individual signal and each worker's group identity. We assume that the effective ability of the worker η_i^t at each stage $t \in \{h, p\}$ is a function of the signal emitted θ_i^t and an error term $\varepsilon_i^t : \eta_i^t = f(\theta_i^t + \varepsilon_i t)$, where i refers to sex, m for male and f for female. The signal θ is normally distributed, $\theta \sim \mathcal{N}(\bar{\theta}, \sigma_\theta^2)$. This distribution is assumed to be the same for both sexes, but depends on whether the individual made an ex ante investment.[3] Let $F_q(\theta^t)$ and $F_u(\theta^t)$ be the cumulative distribution functions of θ for qualified and unqualified workers respectively, and denote by $f_q(\theta^t)$ and $f_u(\theta^t)$ the corresponding density functions. We can reasonably suppose that $F_q(\theta^t) \leqslant F_u(\theta^t)$, which implies that the probability of emitting a high signal is more likely when the worker is qualified. The employer's decision to hire/promote a given individual depends on the signal observed and their prior beliefs about the probability that the worker be qualified. These prior beliefs rely on the subsequent expected propensity to remain in the job, and thus differ by sex. As women are assumed to have greater ability in non-market activities, they are more likely to quit than men; this greater separation probability

[2] Unlike Lazear and Rosen (1990), we do not assume that ability is perfectly revealed to everyone after the initial period of work, during which individuals are reviewed. Since we allow for investment in human capital over the career, noisy signals about qualification remain when the employer takes the promotion decision.

[3] For simplicity, we assume identical ability signal distributions for men and women, but this is not restrictive. Alternative distributional assumptions lead to similar results.

leads to less human-capital investment by women. Anticipating this, the employer's beliefs about the qualification probability differ by sex, so that the assignment process is biased.[4]

Let $\psi_i^t \in [0,1]$ be the employer's prior beliefs about the worker's qualification at stage t. Starting with the hiring stage, the employer observes θ_i^h and makes a hiring decision. We know, by assumption, that $\psi_m^h > \psi_f^h$, and, conditional on θ_i^h and ψ_i^h, the employer formulates a posterior probability that the worker is qualified: we denote this by $\Psi(\psi_i^h, \theta_i^h)$.[5] The employer receives a payoff of $\zeta_q^h(-\zeta_u^h)$ if a qualified (unqualified) worker is hired, and a payoff of *zero* if the worker is rejected regardless of their qualifications.[6] The employer's expected payoff from hiring a worker is thus: $\Psi(\psi_i^h, \theta_i^h)(\zeta_q^h + V(\psi_i^p)) - (1 - \Psi(\psi_i^h, \theta_i^h))\zeta_u^h$, and the expected payoff from rejecting the worker is *zero*. A given worker is hired only if

$$\Psi(\psi_i^h, \theta_i^h)(\zeta_q^h + V(\psi_i^p)) \geqslant (1 - \Psi(\psi_i^h, \theta_i^h))\zeta_u^h,$$

or

$$\frac{\zeta_q^h + V(\psi_i^p)}{\zeta_u^h} \geqslant \frac{1 - \Psi(\psi_i^h, \theta_i^h)}{\Psi(\psi_i^h, \theta_i^h)}, \tag{1}$$

where $V(\psi_i^p)$ is the employer's expected value at the promotion stage if the worker is hired.[7] The employer's policy is then to set, prior to observing a signal, a threshold standard of θ_i^{*h}, respecting the previous hiring condition, and to hire the worker if the signal emitted is no less than θ_i^{*h}. So, for a given observed signal θ_i^h, higher prior beliefs will increase posterior probabilities about the worker's qualification, thus reducing the right-hand side of condition (1) and yielding a lower threshold θ^{*h}.

After hiring and before promotion the employer discovers the hiring-stage investment decision of those workers who were hired. At this stage, the firm knows whether the worker who was hired was actually qualified to be hired. Workers who did not invest at the hiring stage are not eligible for promotion, regardless of their promotion-stage signal. Similarly, conditional upon hiring, the employer will promote a given worker if $\Psi(\psi_i^p, \theta_i^p)\zeta_q^p \geqslant (1 - \Psi(\psi_i^p, \theta_i^p))\zeta_u^p$, since the expected payoff from not promoting is *zero*.

The final payoff to the employer is the sum of the payoffs in each period. There are a number of distinct cases in the model. If the worker is hired after making an initial investment, and invests in the second period and is promoted, the employer's payoff is $\zeta_q^h + \zeta_q^p$. If the worker invests in the two periods but is not promoted, the employer receives $\zeta_q^h + \alpha$. The firm's payoff is $\zeta_q^h - \zeta_u^p$ if a worker is promoted who invests at the hiring stage but not at the promotion stage, and $\zeta_q^h + \alpha$ if this worker is not promoted. If an unqualified worker is hired, the firm receives $-\zeta_u^h$ in the first period and *zero* in the second. We assume that there are no dismissals, so unqualified workers who were hired remain in the job in the second period. Finally, the firm receives a payoff of *zero* if a worker is not hired, regardless of the worker's investment decision.

Now onsider the worker's behavior at each stage. Denote by η_1 the worker's gross return if hired at the first stage and by η_2 the gross return in the second period if promoted conditional upon being hired.[8] The worker has to make an ex ante investment decision about whether undertaking the costly investment, and thus becoming qualified, is worthwhile. This is done by comparing the expected return with investment at the hiring stage to that without investing and remaining unqualified. A rational worker will invest at the hiring stage if the cost of investment is no greater than the net expected benefit over the career.

A qualified worker who has made the costly investment has an expected return (omitting the i subscript) of

$$\eta_1[1 - F_q^h(\theta^{*h})] + \eta_2[1 - F_q^p(\theta^{*p})]\int_0^{\eta_2} h(\omega)d\omega + [1 - F_q^p(\theta^{*p})]\int_{\eta_2}^{\infty} \omega h(\omega)d\omega$$
$$+\eta_1 F_q^p(\theta^{*p})\int_0^{\eta_1} h(\omega)d\omega + F_q^p(\theta^{*p})\int_{\eta_1}^{\infty} \omega h(\omega)d\omega - c^h \tag{2}$$

[4]Note that the employer's beliefs in this model are linked to the worker's qualification via the perceived separation probabilities. Employers might be acting rationally if quit rates are correctly estimated and correspond to female preferences. In this case, their beliefs are consistent with their experiences. However, as we will show later in the model, we do not neglect the effect of the employer's beliefs on women's behavior regarding fertility and hence human-capital investment.

[5]Using Bayes' rule, $\Psi(\psi_i^t, \theta_i^t) \equiv \frac{\psi_i^t f_q(\theta_i^t)}{\psi_i^t f_q(\theta_i t) + (1-\psi_i^t) f_u(\theta_i^t)}$.

[6]We consider that $-\zeta_u^h$ is a recruitment cost, so that $\zeta_q^h = \alpha - \zeta_u^h$, where α is the gross gain from hiring a qualified worker.

[7]This expected value is a function of prior beliefs at the promotion stage, since the signal θ^p has not yet been revealed when making the hiring decision. $V(\psi_i^p) \equiv \psi_i^p \zeta_q^p - (1 - \psi_i^p)\zeta_u^p$, where $\zeta_q^p(-\zeta_u^p)$ is the employer's payoff if a qualified (unqualified) worker is promoted. If the employer decides not to promote a worker who was qualified in the hiring stage, the firm's payoff is *zero*.

[8]We assume for simplicity that the worker's gross return is equal to the average effective ability of all workers at each stage, or equivalently to average output.

and those who do not invest (the unqualified) have an expected return of

$$\eta_1[1 - F_u^h(\theta^{*h})] + \eta_1 \int_0^{\eta_1} h(\omega)d\omega + \int_{\eta_1}^{\infty} \omega h(\omega)d\omega \tag{3}$$

The investment criterion is then[9]

$$\eta_1[F_u^h(\theta^{*h}) - F_q^h(\theta^{*h})] + [1 - F_q^p(\theta^{*p})] \int_{\eta_1}^{\eta_2} H(\omega)d\omega \geqslant c^h \tag{4}$$

The first terms in equations (2) and (3) refer to the expected return in the first period after being hired. This value is the product of the gross return η_1 and the probability of being hired: $[1 - F_q^h(\theta^{*h})]$ if the worker is qualified and $[1 - F_u^h(\theta^{*h})]$ if unqualified.[10] Note that the worker's evaluation of their hiring probability is a function of the threshold they expect to face θ^{*h}, as this probability simply equals the fraction of workers who emit a signal of no less than θ^{*h}.

For a promoted worker, the promotion stage is reflected in the second and third terms, corresponding to the worker staying with the firm and quitting, respectively.[11] The last two terms in equation (2) define the expected return at the promotion stage when the qualified worker is not promoted, with ω denoting the non-market alternative value of time and $h(\omega)$ its corresponding density function. Following Lazear and Rosen (1990), we assume that ω is a random variable, which is revealed to both the worker and the employer only after the promotion stage. Although ω is unknown when both agents make their decisions, the CDF $H(\omega)$ of this variable is known prior to hiring. As our model assumes that women are more likely to quit than men, due to their greater ability in non-market activities, the distribution of reservation wages for women first-order stochastically dominates that of men: $H(\omega_m) > H(\omega_f)$. The cost of being qualified in equation (2) is denoted by c^h, which is assumed to have the same distribution function $G^h(c)$ for both men and women at the hiring stage.

We will now examine how each element in equation (4) affects the share of individuals who choose to become qualified. We in particular show how the threshold standard θ^*, which is a function of the employer's prior beliefs, influences individual behavior, resulting in an equilibrium where beliefs about each group are self-fulfilling. For notational convenience, let b denote the net expected benefit (the left-hand side of equation (4)). It is then straightforward that the fraction choosing to become qualified is determined by $G^h(b)$, the proportion of individuals who have a cost no higher than b. Greater values of b then increase the share of workers who become qualified. As θ^{*h} rises, the probability of being hired due to investment, $F_u^h(\theta^{*h}) - F_q^h(\theta^{*h})$, falls, thus reducing b and the fraction of workers who invest prior to hiring. The threshold standard of promotion θ^{*p} has an analogous effect through the promotion probability, $1 - F_q^p(\theta^{*p})$. As $H_m(\omega) > H_f(\omega)$, all else equal, there is a greater share of qualified men at the hiring stage than qualified women due to the positive relation between $H(\omega)$ and net expected benefits. It follows that a wider wage profile (i.e. a greater gap between η_1 and η_2) leads to higher expected net benefit, and thus a greater fraction of qualified workers.

Conditional on being hired, the worker has to decide whether becoming qualified for promotion is a good investment. The worker again invests if the investment cost does not exceed the net expected benefit over the career.

When the worker invests and becomes qualified for promotion, the expected return is

$$\begin{aligned}\eta_2[1 - F_q^p(\theta^{*p})] \int_0^{\eta_2} h(\omega)d\omega + [1 - F_q^p(\theta^{*p})] \int_{\eta_2}^{\infty} \omega h(\omega)d\omega \\ + \eta_1 F_q^p(\theta^{*p}) \int_0^{\eta_1} h(\omega)d\omega + F_q^p(\theta^{*p}) \int_{\eta_1}^{\infty} \omega h(\omega)d\omega - c^p\end{aligned} \tag{5}$$

The expected return if the worker remains unqualified for promotion is

$$\begin{aligned}\eta_2[1 - F_u^p(\theta^{*p})] \int_0^{\eta_2} h(\omega)d\omega + [1 - F_u^p(\theta^{*p})] \int_{\eta_2}^{\infty} \omega h(\omega)d\omega \\ + \eta_1 F_u^p(\theta^{*p}) \int_0^{\eta_1} h(\omega)d\omega + F_u^p(\theta^{*p}) \int_{\eta_1}^{\infty} \omega h(\omega)d\omega\end{aligned} \tag{6}$$

[9]The details behind the derivation of this condition appear in Appendix A.

[10]We assume that the expected return when the worker is not hired is *zero*.

[11]Qualified workers have a chance of being promoted in the second period and obtaining η_2, in contrast to unqualified workers, who retain the same payment as in the first period.

The worker thus invests in promotion if the following condition holds[12]

$$(F_u^p(\theta^{*p}) - F_q^p(\theta^{*p})) \int_{\eta_1}^{\eta_2} H(\omega)d\omega \geqslant c^p \tag{7}$$

This investment condition at the promotion stage is a function of the threshold standard for promotion θ^{*p}, the distribution of reservation wages and the wage profile. These factors play the same role as in the hiring stage in determining the fraction of workers who undertake the costly promotion investment.

We now consider how the equilibria are determined following on from the analysis above. Equilibrium at each stage is defined as a pair of self-fulfilling employer beliefs about the fraction of workers of each sex who undertake the requisite investment for stage t. Different expectations about the separation rates by sex determine the employer's prior beliefs, and these beliefs establish the equilibrium ability cutoffs by sex. Workers make their investment decision at each stage while anticipating the employer's behavior as well as their own probability of quitting.

We specify equilibrium at the hiring stage as:

$$\psi_i^{*h} \equiv G^{*h}(c^h(\theta_i^{*h}(\psi_i^h, \psi_i^p))) \tag{8}$$

$$c_i^{*h}(\theta_i^{*h}, \theta_i^{*p}, H_i(\omega), \eta), \qquad \theta_i^{*h}(\psi_i^h, \psi_i^p) \qquad i = m, f.$$

and equilibrium at the promotion stage as:

$$\psi_i^{*p} \equiv G^{*p}(c^p(\theta_i^{*p}(\psi_i^p))) \tag{9}$$

$$c_i^{*p}(\theta_i^{*p}, H_i(\omega), \eta), \qquad \theta_i^{*p}(\psi_i^p), \qquad \psi_i^p(c_i^{*h}) \qquad i = m, f.$$

These equilibria have straightforward implications, not only for gender differences in terms of hiring and promotion but also (and in particular) for the distribution of ability.

Under our previous assumptions ($F_m^h(\theta)$ and $F_f^h(\theta)$ are identical at the hiring stage, and similarly for $G_m^h(c)$ and $G_f^h(c)$):

1. All else equal, women are less likely to be hired
   $1 - F_f^h(\theta_f^{*h}) < 1 - F_m^h(\theta_m^{*h}) \quad \text{if } \theta_f^{*h} > \theta_m^{*h}$
2. As a result, conditional upon being hired, women are on average more productive than their male colleagues. The investment condition in equation (4) involves $G_m^h(c_m^{*h}) > G_f^h(c_f^{*h})$, since $c_m^{*h} > c_f^{*h}$

The lower equilibrium cost cutoff for women then means that, even though fewer women undertake the costly investment, those women who do invest are on average more qualified than are the men who do so. This is an obvious, but key, result, as it shows how the subsequent stages interact with each other and affect individual decisions. This modifies the main equilibrium results found in standard promotion models, and so is central to our contribution here.

This gap in average productivity between men and women appears in their promotion stage investment cost distribution functions. The cost distribution for men first-order stochastically dominates that for women, $G_m^p(c) < G_f^p(c)$. We may then plausibly think that at the promotion stage the employer's prior beliefs ψ_i^p should change to become relatively more optimistic about women's qualifications relative to men's. This simple intuition is found in Fryer (2007), who refers to it as "belief flipping". Although there may be discrimination against women in hiring, the group who manages to overcomes this initial adversity may be favored in promotions, since they have previously been held to a more exacting standard. As a result, the female promotion threshold is no greater than that for men, and the fraction of women who invest for promotion is at least as large as that of men.

3 The Egyptian labour market context

Egypt is one of the largest economies in the Middle East and North Africa (MENA). However, its performance in terms of both gender equality and women's opportunities in the labour market remains among the worst in both the region and the world. According to the gender gap report of the World Economic Forum, Egypt ranked 125^{th} out of 136 countries in terms of the gender gap in 2013. The female labour-force participation rate is not only low but its increase over time has been very modest and less than

[12]See Appendix A for the details regarding this result.

expected, given the great improvement in women's education.[13] Furthermore, labour-force participation fell in the $2000's$ for educated women, and the small rise for less-educated women was exclusively due to their participation in unpaid work (Assaad, 2014).

Since the beginning of the 1990's Egypt has witnessed considerable changes as a result of a number of liberalisation policies, which notably affected the structure of the labour market and especially the position of women. The Economic Reform and Structural Adjustment Program (ERSAP) was implemented in 1991 in order to relieve fiscal and external imbalances in Egypt, as was the case in many other developing countries. One of the main objects of this program was the privatisation of State-owned enterprises and the scaling-down of the role of the government as an employer. The public sector had always been the principal employer of Egyptian women, especially those who have ever been married, given the fit between work there and family responsibilities (e.g. flexible hours of work, paid maternity leave). This retrenchment in the role of the public sector thus significantly affected women's employment, and in particular ever-married women with education above the technical high school level.[14]

Regarding female employment by age, Assaad and Arntz (2005) show that although an increase in public-sector female employment was observed during the ERSAP program, this reflected delayed exit from government employment for older women who held on to their jobs, as they realised that the government hiring of younger workers had declined. Both State-owned enterprise and private-sector employment fell over this period.[15] It appears that during that period, men were able to find jobs in the private sector to compensate for the decline in the public sector. Conversely, the private sector, as Assaad argues, seems to be particularly closed to women in Egypt.[16]

This decline in female employment, which was not compensated by an increase in private-sector opportunities, led to higher unemployment for women, which was accentuated by the willingness of women to queue for public-sector employment.[17] Women's labour-market status is thus precarious, not only with respect to earnings, but also in terms of hiring and access to employment.[18]

An additional factor restricting female employment is sex differences in the ability to respond to the changing geography of employment opportunities (Assaad and Arntz, 2005). Industrialisation and structural adjustment has considerably changed labour market by moving productive activities outside of the city (e.g. to specialised industrial towns) which thus have become less accessible for women. Women's limited geographical mobility, for cultural and family reasons, has then further restricted their job-search and employment opportunities. This is one reason for lower female wages in Egypt. While previously women were easily able to move from home to work, this is now no longer possible and many women prefer not to work at all or to work closer to home.[19]

4 Data and model suitability

4.1 The data

We appeal to two sources of data in our work here. We rely primarily on the Egyptian Labour Market Survey (ELMS) for 2006.[20] This is a cross-section household survey, carried out by the Economic Research Forum (ERF) in cooperation with CAPMAS,[21] and was graciously made available to us by *The Population Council* and *The Social Research Center of the American University in Cairo.* We also use data from the Egypt Demographic and Health Survey (EDHS) for 2008.[22]

[13] The female labour-force participation rate, as a percentage of the working-age population (15 – 64), increased from about 20% in 1998 to 22% in 2004 (ILO 2003 – 04, UNDP/ILO, 2004). It was 24, 4% in 2009 and is today around 26%, as opposed to a figure of 79% for men (World Bank - World Development Indicators).

[14] Technical high-school education is required in order to be eligible for the government employment-guarantee scheme.

[15] Female non-governmental paid employment declined at an annual rate of 1.4%, while that of men rose by 2.4%.

[16] Female paid employment in the private sector fell by 0.5% per annum.

[17] Although the female unemployment rate fell recently from 24% in 2006 to 18, 60% in 2009, it increased again to 19% in 2010 and 23% in 2013, compared to 6% and 5% for men in 2010 and 2013, respectively (World Economic Forum).

[18] For further details on the Egyptian labour market and female employment, see Assaad (2009, 2014)

[19] Urban female commuting rates - measured as the proportion commuting to a different geographical agglomeration to go to work - in 1988 were about half those of men, 3.6% and 6.5% respectively, with the difference being statistically significant at the 1% level (Assaad and Arntz, 2005). However, in 1998 after the implementation of structural adjustment and the need to commute in order to obtain work, male commuting rates rose significantly (8.3%) while those of women were almost unchanged (3.8%). Married women are obviously less mobile than single women, both in 1988 and 1998. On the contrary, the difference in commuting rates between married and single men in 1988 was no longer significant in 1998. Single men, who were less mobile than their married counterparts before the structural adjustment, had increased their commuting rates by 1998 in order to obtain jobs.

[20] For details on the sampling, data description and questionnaire design of the ELMS, see Assaad and Barsoum (1999), and Barsoum (2007), Final Report. The Population Council, Cairo, Egypt.

[21] Central Agency for Public Mobilization and Statistics.

[22] The 2008 Egypt Demographic and Health Survey (2008 EDHS) was conducted on behalf of the Ministry of Health by El-Zanaty and Associates.

There are three sources of information in the ELMS questionnaire: the household questionnaire, the individual questionnaire, and the household enterprise and income module (which contains information on all of the agricultural and non-agricultural activities carried out by the household, as well as migration, remittances, transfers and all non-labour income). The household basic characteristics apply to all current members of the household and are collected from the most-knowledgeable person. Individual characteristics are collected for individuals aged six and above. The information from the third questionnaire comes from the most-knowledgeable person in the household.

For the analysis of promotions, we restrict our sample to regular wage earners who have finished their education and are aged between 16 and 65, with valid observations on all of the variables used in our model.[23] However, since we account for hiring/self-selection into the labour market, we also use data from the full sample of working and non-working individuals aged between 16 and 65,[24] which after data cleaning yields observations on 8609 men and 7109 women.

We measure promotion opportunities in the main job.[25] Each worker was asked how many times he or she has been promoted since starting the current job. Answers of once, twice and three or more times reflect positive promotions, while replying never been promoted or does not apply correspond to no promotion opportunities. Two points should be made regarding this specification of promotion outcomes. First, we cannot distinguish between workers who have never been promoted in jobs offering promotion opportunities and those who are in jobs that do not offer promotion opportunities. This will bias our estimation of the promotion differential between men and women if women are less promoted because they are more frequently in "dead-end" jobs with no promotion opportunities. Second, the promotion variable specified here has the advantage of ensuring that job changes were indeed a step up to a higher hierarchical level. However, the questionnaire does not make it clear whether the worker has been with the same employer since the first job, or rather has moved between jobs. This is a problem as women are supposed to be less mobile than men. As such, conditional on employment, the separation probability should be lower for women than for men, which could lead to the underestimation of the gender difference in promotion. Although, "stayers" and "movers" cannot easily be identified here, we do make an attempt to distinguish them. Workers who currently report having jobs in the location, industry and occupation as in their first job are defined as "stayers".[26] Considering only stayers defined in this way leaves us with 6568 observations on men and 6701 on women for our empirical analysis.

We pick up the employer's perception of the different separation rates by sex via a fertility index, which proxies for women's higher quit rates due to childbearing. The data here comes from the Egypt Demographic and Health Survey EDHS for 2008. Following Winter-Ebmer and Zweimuller (1997), we calculate the fertility index according to the woman's age and current number of children, as follows:

$$F_{jk} = 1 - \prod_{l=1}^{5} [1 - P(\text{birth}|\text{age}\, j + l, \text{n}^{\circ} \text{ of children } k)], \qquad (10)$$

where the fertility index F_{jk} shows the probability that a woman of age j having k children will bear a further child within the next five years.

4.2 The suitability of the model

We here present some preliminary evidence in support of our model. Figure 1 in the Appendix compares the male and female density functions of education[27] (the left-hand side column) and the corresponding cumulative distribution functions (the right-hand side column) for three distinct samples.[28] The first row covers the entire sample used in our empirical analysis, including employed and non-employed respondents. The second corresponds to wage workers, and the last refers to those who were promoted. As can be seen, the male education distribution function first-order stochastically dominates that of

[23] A detailed description of the variables used in our estimations appears in Appendix B.

[24] Employers, the self-employed and the unpaid working for family are excluded from the sample.

[25] The period of reference for the main job is the entire three-month period preceding the survey, corresponding to three months of wage payments.

[26] The same location denotes the same governorate, city or town and urban/rural areas. The sectors are government, public enterprise, private, investment, foreign, non-profit government organisation, and other including co-operatives. Given the possibility of privatisation of some enterprises during the career, individuals may have been with the same employer while the sector changed. These individuals are considered as stayers according to the previous definition. In these cases the sector at the first job was government or public enterprise, but then became private sector. There were only 14 observations (10 men and 4 women) in this situation.

[27] Education corresponds to the number of years of schooling.

[28] The estimation procedure was via a kernel-density with an Epanechnicov kernel function.

women in the first row of the figure.[29] However, after hiring, working women are now more qualified than are men. The female distribution function of education in the second and third rows of Figure 1 first-order stochastically dominates the male distribution. Table 3 illustrates the same findings:[30] the average number of years of schooling is higher for men than for women in the whole sample, while women have more years of schooling in both the working and the promoted groups.[31] In addition, Table 4 shows that women are less likely to be hired than men (19, 18% versus 54, 66%). They also have less chance of being promoted unconditional on being hired, but strikingly are more frequently promoted than men conditional on being hired (49.9% versus 34.3%). These figures imply that the hiring threshold for women is greater than that for men. When the male ability distribution first-order stochastically dominates that of women, women could still be less frequently hired if the male hiring criteria is greater than that for women. However, for women to be simultaneously less likely to be hired and more qualified after hiring, they have to face tougher hiring criteria than do men. We thus have some preliminary support for our model. Adversity against women at hiring, which leads the employer to set more stringent hiring standards, results in working women being more qualified on average than their male colleagues. This adversity may then turn in their favour during the promotion stage, with women having at least the same promotion opportunities as men.

5 Model specification

5.1 Estimation of a multivariate promotion model by maximum simulated likelihood

Following the theoretical model, our approach here considers that human-capital investment and fertility are jointly determined, with both being endogenous to hiring and promotion. This approach therefore affirms neither unidirectional nor bidirectional causality between education and fertility. These are simultaneous decisions, not with respect to the time at which they occur but in the sense that they are the joint solution to a common constrained-maximisation problem. The model in addition analyses promotions accounting for selection into the labour market. Our model thus contains equations for four response variables, of which the promotion probability p is viewed as the primary variable of interest. The variable s reflects selection, which can also be defined as the hiring probability. Fertility f and education e are endogenous regressors in this model of hiring and promotion.

Formally, we use a multivariate probit model where, for individual $i = 1, ..., n$ and sex $g = m, f$, the following equations are estimated simultaneously:[32]

$$Selection: \qquad s^*_{ig} = x_{ig1}\beta_1 + \tilde{f}_{ig}\alpha_1 + e_{ig}\alpha_2 + \varepsilon_{i1} \tag{11}$$

$$Fertility: \qquad f^*_{ig} = x_{ig2}\beta_2 + e_{ig}\tau_2 + s_{ig}\kappa_2 + \varepsilon_{ig2} \tag{12}$$

$$Education: \qquad e^*_{ig} = x_{ig3}\beta_3 + \varepsilon_{ig3} \tag{13}$$

$$Promotion: \qquad p^*_{ig} = z_{ig}\gamma + \tilde{f}_{ig}\delta_1 + e_{ig}\delta_2 + \varepsilon_{ig4} \tag{14}$$

where x_{1i}, x_{2i}, x_{3i} and z_{ig} are vectors of exogenous covariates for individual i of sex g, and the coefficients β_1,β_2,β_3 and γ are the corresponding vectors of parameters. $\varepsilon_1, \varepsilon_2, \varepsilon_3$ and ε_4 are error terms distributed multivariate normally, each with a mean of *zero*, and variance-covariance matrix Σ. For identification purpose, the variances of the error terms must be set to 1. We do not observe the latent variables, $s^*_{ig}, f^*_{ig}, e^*_{ig}, p^*_{ig}$. We instead use observable variables, defined as follows: $f_{ig} = 1(f^*_{ig} > 0)$ and $e_{ig} = 1(e^*_{ig} > 0)$, where $1(.)$ is the usual indicator function.

From the theoretical model, the risk of quitting is determined by the fertility propensity f^*_{ig}, which is approximated in our model by the number of children the woman has. We thus consider simply that f_{ig}

[29] Although our model assumes for illustrative purposes that prior to being hired both genders have identical distributions of the ability signal and cost, alternative distributional assumptions do not change our main hypotheses. That is, in order for women to simultaneously be less likely to be hired and be more qualified after hiring than their male colleagues, they have to face tougher hiring criteria than do men.

[30] All statistics are weighted by the appropriate survey sampling weights.

[31] The percentage of both working and promoted women who have attained high levels of education is distinctly greater than that of their male colleagues, while this percentage is not significantly different between the two genders in the whole sample. We denote by high education general and vocational high schools, post-secondary, university and above university degrees, while low education corresponds to the illiterate, literate without any diploma, elementary and middle-school degrees.

[32] The simultaneous estimation allow us to identify the correlation coefficients among the stochastic components of all the dependent variables in our model, and so account not only for endogeneity but also selection.

in equation (12) equals one if a woman has children and *zero* if she does not.[33] The fertility propensity in this specification is probably endogenous in our model. To account for endogeneity, equations (11) and (14) use our computed demographic fertility index $\tilde{f}_{ig}$, as defined in equation (10). In this case, $\tilde{f}_{ig}$ equals one if the probability that a woman will bear further children within the next five years is greater than 0.5 and *zero* otherwise.[34] In the theoretical model we assume that both hiring and promotion depend on the employer's beliefs about quit rates, which are determined by the expected propensity to fertility $\tilde{f}_{ig}$, rather than actual fertility. This means that hiring and promotion are orthogonal to actual fertility conditional on $\tilde{f}_{ig}$. Education also enters as a binary variable, with value one for a high level of education and *zero* for a low level.

The hiring and promotion probabilities are defined as: $s_{ig} = 1(s^*_{ig} > \theta^{*h}_g)$ and $p_{ig} = 1(p^*_{ig} > \theta^{*p}_g)$. The individual is thus hired (promoted) if their propensity to be hired (promoted) is greater than $\theta^{*h}_g(\theta^{*p}_g)$, with θ^{*h}_g and θ^{*p}_g being the hiring and promotion threshold standards, respectively.[35] These last two equations provide the threshold conditions for hiring and promotion, implicitly defined by equations (4) and (7).

In the fertility equation (12), education is endogenous to fertility propensity. We therefore use father's education, employment status and job sector as exclusion restrictions in order to identify the fertility equation. Since the level of education attained is also endogenous to hiring and promotion, we also use the number of siblings as an additional instrument in order to identify the hiring and promotion equations. The number of siblings is supposed to negatively affect education, but has no direct effect on hiring and promotion. In our model we also consider that the hiring probability affects the fertility propensity. Hence, for identification purposes, non-labour income appears in the hiring equation as our exclusion restriction.[36] With this specification, our simultaneous-equation model is identified. Each equation in our model satisfies both the order and rank conditions.[37] The over-identifying restrictions tests were carried out using the Amemiya-Lee-Newey minimum Chi-squared test statistic, which corresponds to the over-identification test statistic proposed by Hausman (1983). These Chi-squared distribution test statistics appear in Table 2 in the Appendix, for both genders and each subsample. In all cases, we accept the hypothesis of exogeneity: the tests reject the presence of exogenous variables in the model that have inappropriately been omitted from the equation under consideration.

5.2 The decomposition of promotion inequality: the generalised-residuals approach

Our aim is to see whether there is a gender gap in promotion, once we take into account the hiring process, and once we control for differences in endowments and separation probabilities by sex. We refer to this remaining gap as unequal promotion opportunities. Unequal promotion may reflect either the different evaluation of endowments or unjustifiable promotion threshold differences between men and women. It is worth noting that the risk of quitting as predicted by the employer could be seen as a form of statistical discrimination (Phelps, 1972) if the firm misperceives female separation rates - mainly as a result of a "stereotyping" - or if these prior beliefs have feedback effects, and therefore change individual quit behaviour. As such, if the separation probabilities are correctly anticipated, the difference in promotion opportunities due to a gender gap in separation probabilities could then be considered as reflecting efficient promotion, and there is no gender discrimination in this case.

The decomposition method we adopt here is based on the Generalised Selection Bias (GSB) approach, which has been used to decompose wage differentials or probit models when there are selection effects.[38] The principal idea behind GSB is that the decomposition is based on the joint estimation of the structural and selection equations using Maximum Likelihood (ML) in order to evaluate the selection bias.[39] This is the main reason why we choose to implement the GSB methodology. In particular, this provides a general framework for decomposition analysis which can be extended to of multivariate

[33] This specification has been applied by Di Tommaso (1999).

[34] Obviously, equation (12) is estimated only for women. Since the fertility propensity determines the separation probability, we implicitly assume that the risk of quitting for males is *zero*. Thus, our model only addresses quitting for non-market activities, with job-to-job quits not being considered.

[35] Remember that our theoretical model predicts that the female hiring threshold standard should be greater than that for men, while their promotion threshold standard should be the same as, if not less than, that of their male colleagues.

[36] Unfortunately, we did not consider the effect of fertility on education, due to the lack of a credible instrument. We attempted to use the number of dead births as an instrument, which is positively significantly correlated with fertility propensity, but the test for the exogeneity of this variable in the education equation was rejected. As expected, the number of dead births is negatively correlated with education.

[37] There are at least as many exogenous variables excluded from each equation as the number of endogenous variables included in this equation. The rank condition is also satisfied.

[38] See Yun (1999) and Yun (2000).

[39] As opposed to the "selection bias correction approach" (SBC), which relies rather on the two-step method in Heckman (1979).

case.[40] Here the calculation of the selection bias relies only on the expectations of the residuals calculated using the consistent estimates from the joint estimation, and hence - as described below - does not require the calculation of the analytical formula for the selection bias. This makes the decomposition analysis much easier and more feasible, especially when we have to evaluate a multivariate-normal distribution, but somewhat more complicated than the standard two-equation model.

This approach also provides us with a suitable decomposition analysis. First, it is based on full-information MSL estimation, and is hence efficient. Second, it uses the joint simulated estimation ML method, which allows us to obtain consistent estimates of parameters by accounting for the correlation between the stochastic components of our model.

We now formally show how we apply the GSB approach to our multivariate probit model. We want to evaluate the gender gap in observed promotion probabilities, that is the average expectation of p_{ig} conditional on being hired and taking endogeneity into account. We can then define the conditional expectation of the stochastic element ε_{ig4} given the values of the other equations as $E(\varepsilon_{ig4}|s_{ig}, z_{ig}, \tilde{f}_{ig}, e_{ig}) = \Lambda_{ig}$,[41] and its conditional variance by $V(\varepsilon_{ig4}|.) = \sigma^2$.

Assume that we obtain consistent estimates of our model via maximum simulated likelihood. Then, the promotion equation (14) given the values of the other equations and using our consistent estimators is:

$$p^*_{ig} = z_{ig}\hat{\gamma} + \tilde{f}_{ig}\hat{\delta}_1 + e_{ig}\hat{\delta}_2 + \hat{\Lambda}_{ig} + \hat{\epsilon}_{ig}, \tag{15}$$

where $\hat{\gamma}, \hat{\delta}_1, \hat{\delta}_2$ is the vector of consistent estimators, $\hat{\varepsilon}_{ig4} = \hat{\Lambda}_{ig} + \hat{\epsilon}_{ig}$, $\hat{\Lambda}_{ig} = E(\hat{\varepsilon}_{g4}|.)$,
$\hat{\epsilon}_{ig} = \hat{\varepsilon}_{ig4} - \hat{\Lambda}_{ig}$, $E(\hat{\epsilon}_{ig}|.) = 0$, and $V(\hat{\epsilon}_{ig}) = \hat{\sigma^2}$.

The conditional expectation of $p_{ig}, E(p_{ig}|.)$, i.e. the conditional probability of promotion ($Pr(p_{ig} = 1|.)$), is given by $\hat{P}_{ig|.} = \Phi((z_{ig}\hat{\gamma} + \tilde{f}_{ig}\hat{\delta}_1 + e_{ig}\hat{\delta}_2 + \hat{\Lambda}_{ig})/\hat{\sigma})$.

Similarly, we denote the unconditional probability of promotion by
$\hat{P}_{ig} = \Phi((z_{ig}\hat{\gamma} + \tilde{f}_{ig}\hat{\delta}_1 + e_{ig}\hat{\delta}_2)/\hat{\sigma}_{\varepsilon g4})$, where $V(\hat{\varepsilon}_{ig4}) = \hat{\sigma}^2_{\varepsilon g4} = 1$.

Therefore, asymptotically, the average conditional expectation of p_{ig} can be written as,

$$\bar{p_g} = \overline{\hat{P}}_{g|.} = \overline{\Phi\left(\frac{z_{ig}\hat{\gamma} + \tilde{f}_{ig}\hat{\delta}_1 + e_{ig}\hat{\delta}_2 + \hat{\Lambda}_{ig}}{\hat{\sigma}}\right)}$$

This average conditional probability (the observed promotion probability) is the product of two effects: the average unconditional expectation of p_{ig} ($\overline{\hat{P}}_g$), and the average effects of the other equations on the promotion probability, which we denote by $\overline{\hat{P}}_{g\hat{\Lambda}_g} = \bar{p_g} - \overline{\Phi(z_{ig}\hat{\gamma} + \tilde{f}_{ig}\hat{\delta}_1 + e_{ig}\hat{\delta}_2)}$. We thus have: [42]

$$\bar{p_g} = \overline{\hat{P}}_{g|.} = \overline{\hat{P}}_g + \overline{\hat{P}}_{g\hat{\Lambda}_g} \tag{16}$$

$$= \overline{\Phi(z_{ig}\hat{\gamma} + \tilde{f}_{ig}\hat{\delta}_1 + e_{ig}\hat{\delta}_2)} + [\bar{p_g} - \overline{\Phi(z_{ig}\hat{\gamma} + \tilde{f}_{ig}\hat{\delta}_1 + e_{ig}\hat{\delta}_2)}] \tag{17}$$

The first term at the right-hand side of equation (17) is the univariate standard normal distribution function, and the second (the effects of the other equations) is simply the difference between the observed promotion probability and the average unconditional expectation of p_{ig}. As noted above, on advantage of this decomposition approach is that it does not require the explicit calculation of the analytical formula for $\overline{\hat{P}}_{g\hat{\Lambda}_g}$.

The difference in the observed promotion probability between males and females can then be decomposed as follows:

[40]Almost all work which has attempted to analyse gender wage inequality has been restricted to models with single selection (i.e. a two-equation model), using Heckman's two-step method or Maximum Likelihood, because no methods were available to carry out decompositions when more than two equations were estimated simultaneously.

[41]Λ_{ig} is the vector of the so called "generalised residuals". See Gourieroux et al. (1987).

[42]For notational purposes, the normalised standard error $\hat{\sigma}_{\varepsilon g4}$ is omitted here.

$$
\begin{aligned}
\bar{p_m} - \bar{p_f} &= [\overline{\Phi(z_{im}\hat{\gamma}_m + e_{im}\hat{\delta}_{2m})} - \overline{\Phi(z_{if}\hat{\gamma}_f + e_{if}\hat{\delta}_{2f} + \tilde{f}_{if}\hat{\delta}_1)}] + \overline{\hat{P}}_{m\hat{\Lambda}_m} - \overline{\hat{P}}_{f\hat{\Lambda}_f} \\
&= [\overline{\Phi(z_{im}\hat{\gamma}_m + e_{im}\hat{\delta}_{2m})} - \overline{\Phi(z_{if}\hat{\gamma}_m + e_{if}\hat{\delta}_{2m})}] \\
&\quad + [\overline{\Phi(z_{if}\hat{\gamma}_m + e_{if}\hat{\delta}_{2m})} - \overline{\Phi(z_{if}\hat{\gamma}_f + e_{if}\hat{\delta}_{2f})}] \\
&\quad + [\overline{\Phi(z_{if}\hat{\gamma}_f + e_{if}\hat{\delta}_{2f})} - \overline{\Phi(z_{if}\hat{\gamma}_f + e_{if}\hat{\delta}_{2f} + \tilde{f}_{if}\hat{\delta}_1)}] \\
&\quad + \overline{\hat{P}}_{m\hat{\Lambda}_m} - \overline{\hat{P}}_{f\hat{\Lambda}_f}
\end{aligned}
\tag{18}
$$

The first element in this equation represents the difference in promotion opportunities due to differences in the observed characteristics by sex, and the second is the effect of differences in the corresponding coefficients. The effect of efficiency in promotion, which reflects differences in separation probabilities, corresponds to the third term, and the last term picks up differences in the effects of the other equations on promotion probabilities by sex.

6 Results

Before examining in detail gender inequality in hiring and promotion, we will glance at the results of the maximum simulated likelihood MSL model. The estimation results appear in Tables 8 to 11 of the Appendix separately by sex.[43]

The model was run for both the whole sample (movers and stayers), and only for stayers as defined previously. In Tables 8 and 10 we compare the results for men and women without considering the effect of the employer's beliefs regarding the risk of quitting on hiring and promotion. We thus neglect at this stage women's fertility propensity. We refer to this model as model 1.[44] As can be seen, the correlation coefficients for the stochastic components of the selection and promotion equations are positive and statistically significant in each model and for both genders.[45] This means that the hiring stage has a non-negligible effect on promotion probabilities, so that including it is important for the analysis of unequal promotion opportunities for men and women. Investment in human capital is endogenous to both hiring and promotion, except in the entire sample of men. The correlation between the stochastic components of the education and hiring equations is not statistically significant.[46] Considering the estimates of the threshold standards, they are all positive and statistically significant. We note that for both genders the thresholds for promotion are higher than those for hiring. We find, in line with our theoretical model, that the hiring threshold for women is higher than that for men. The female promotion standard is also somewhat greater than that in model 1, where we do not yet account for the effect of the risk of quitting.

Tables 9 and 11 show our estimates of the full model which includes women's fertility. In a first estimation, we approximate the separation probability by the number of children the women has: this is model 2.[47] In model 3 we employ the fertility index, as computed from equation ((10)) as an explanatory variable in both the hiring and promotion equations. We suppose that the separation probability, as approximated in model 2, is possibly endogenous in our model. Employer's beliefs have feedback effects on women's behavior. Any expected hiring and promotion discrimination could discourage women from human-capital investment, facilitate fertility decisions, weaken their attachment to the labour force, and thus increase their quit rates. This is why we use the demographic fertility index in model 3, which is considered to be exogenous in our model, and is hence supposed to provide better information about employer expectations of separation probabilities. These two models yield almost identical results. Nevertheless, it is worth noting some important issues, particularly in comparison to model 1. First, once we include the employer's expectation of the risk of quitting (the fertility propensity) in the hiring and promotion equations, the threshold standards fall considerably, and are insignificant in the hiring equation. Our variable of interest, fertility propensity, always attracts the expected negative and significant coefficient in the hiring and promotion outcomes. It thus seems that employer beliefs about the risk of quitting do have a non-negligible effect in determining women's hiring and promotion criteria. This appears to confirm to some extent the hypotheses in our theoretical model.

[43] A likelihood-ratio test rejects simultaneously the hypotheses of equal parameters between men and women for all the respondent variables in our model with a p-value of *zero*. The hypotheses of equal parameters is also rejected for each equation separately (a p-value of *zero* for the selection and promotion equations, and a p-value of $0,0014$ for the education equation).

[44] Remember that we assume that the risk of quitting is *zero* for men.

[45] Those who have been hired are more likely to be promoted.

[46] A likelihood ratio test for the absence of correlation between the stochastic components of all of our models is rejected with a p-value of *zero* for both genders.

[47] The estimations of this model are not presented here. They are available from the author upon request.

Decomposition analysis

Tables 4 to 7 in the Appendix show the average predictions of the marginal distribution functions for the hiring and promotion equations, the conditional distribution functions of promotion, and the counterfactual distributions for women.[48] For the sake of comparison, both predicted and observed probabilities are also reported.[49]

The results of the decomposition analysis are summarised in Table 1. The first two panels compare full sample to the group of stayers.

Regarding the hiring distribution functions (the left-hand side of Table 1), we see that women are on average less likely to be hired than are men. This hiring gap is smaller for stayers. The raw differential in model 1 is about 35 percentage points in favour of men for the whole sample, and 25.5 percentage points for stayers. The main part of this differential results from differences in coefficients and unjustifiable gaps in hiring threshold standards.[50] The effect of differences in characteristics is rather in women's favour.

Models 2 and 3 show that efficient hiring which accounts for expectations of separation rates reduces female hiring. That is, were women to have the same separation risk as men, or rather were the employer to believe so, the probability that a women would be hired rises by nearly 12 percentage points in the whole sample and 11 percentage points for stayers. Around 32% (38%) of the hiring differential for the whole sample (stayers) then comes from efficient hiring reflecting different expectations regarding separation rates. The efficiency effect in model 3 is somewhat smaller than in model 2, suggesting that our calculated demographic fertility index is a more suitable control for the endogeneity of the separation risk.

The theoretical model suggests that conditional on being hired women do not have lower promotion opportunities than their male colleagues. The estimated results show that women have an advantage over men in terms of promotion opportunities of about 10 percentage points in the whole sample. Not surprisingly, this gap is higher for stayers. However, this advantage is mainly due to differences in the effect of the other equations on the promotion probabilities $\Delta(\overline{\hat{P}}_{g\hat{\Lambda}_g})$ and endowments. These findings are in line with our model, which asserts that conditional on being hired women are on average more qualified than their male colleagues. The unexplained part is 8 percentage points (for the whole sample) and 4 percentage points (stayers) in the first model. Nevertheless, when we account for differences in promotion opportunities due to efficient promotion (models 2 and 3), the effect of differences in the coefficients and threshold standard disappears, and even turns in favour of stayer women.

Hiring and promotion are very likely different between the public and the private sectors. This may substantially affect male and female differentials in terms of hiring and promotion, especially as women are more likely to be in the public sector than are men (female entry into the private sector being more difficult). We thus refine our analysis by splitting our sample of stayers into the public and private sectors, and run our MSL model for each sex and sector separately.[51] The third and fourth panels in Table 1 show the decomposition analysis for the public and the private sectors, respectively.[52] As expected, gender inequality in hiring is distinctly larger in the private than the public sector. The advantage of women in terms of endowments is only seen in the private sector. This suggest that women have to reach higher ability standards than men to be hired, so that lower-educated women face barriers to entry in the private sector. Conditional on being hired, there is still an unexplained differential in promotion opportunities between men and women in the public sector, even when efficient promotion is considered. However, it seems that in the private sector unequal treatment in promotion opportunities disappears.[53] Since women have been held to a more exigent hiring standard than are men, the successful group who reach these standards are more qualified than their male colleagues. Employer beliefs then become more optimistic about female separation rates and women are treated the same as men, at least during the promotion stage.

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[48]The counterfactual distribution is defined as the hiring (promotion) distribution function for men that would prevail were all their covariates to be distributed as for women.

[49]Note that we calculate average predicted probabilities, and not probabilities for a representative individual with average endowments.

[50]It is worth noting that differences in coefficients can be interpreted as discrimination, if we consider that the employer is entirely responsible for hiring, or as differences in the behavioral response to individual characteristics when we are talking about self selection into employment. We unfortunately cannot be sure that this unexplained part is entirely due to employer discrimination.

[51]The estimates from these models are not presented here. They are available from the author upon request.

[52]Unfortunately, we were not able to estimate models 2 and 3 in the private sector due to the small size of the sample.

[53]Although results including efficient promotion are not available for the private sector, we would expect at least an insignificant effect of the unexplained component, and even positive discrimination in favour of women.

Table 1: Decomposition of the gender difference in hiring and promotion cumulative distribution functions (Standard errors in parentheses†)

	Hiring			*Promotion*		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
A*ll*						
Raw	35,12*** (0,0027)	37,92*** (0,0035)	37,99*** (0,0035)	-9,52*** (0,0078)	-9,89*** (0,0088)	-10,45*** (0,0090)
Covariates	0,63* (0,0026)	-4,28*** (0,0029)	-4,28*** (0,0029)	-4,85*** (0,0058)	-5,74*** (0,0065)	-5,74*** (0,0067)
Unexplained (coeffs+threshold θ^*)	34,48*** (0,0017)	28,67*** (0,0025)	30,19*** (0,0024)	8*** (0,0020)	0,55*** (0,0032)	2,06*** (0,0029)
Efficiency	-	13,52*** (0,0016)	12,08*** (0,0015)	-	6,61*** (0,0022)	4,95*** (0,0016)
Effects of other equations $\Delta(\overline{\hat{P}}_{g\hat{\Lambda}_g})$	-	-	-	-12,57*** (0,0040)	-11,31*** (0,0038)	-11,72*** (0,0038)
S*tayers*						
Raw	25,49*** (0,0024)	27,92*** (0,0029)	27,91*** (0,0029)	-11,51*** (0,0095)	-13,30*** (0,0107)	-13,82*** (0,0110)
Covariates	-0,98*** (0,0024)	-5,72*** (0,0026)	-5,72*** (0,0026)	-4,28*** (0,0057)	-5,76*** (0,0067)	-5,76*** (0,0067)
Unexplained (coeffs+threshold θ^*)	26,47*** (0,0017)	20,97*** (0,0024)	23,02*** (0,0023)	4,16*** (0,0020)	-1,97*** (0,0035)	-0,17 (0,0033)
Efficiency	-	12,67*** (0,0016)	10,62*** (0,0014)	-	6*** (0,0022)	3,97*** (0,0015)
Effects of other equations $\Delta(\overline{\hat{P}}_{g\hat{\Lambda}_g})$	-	-	-	-11,40*** (0,0053)	-11,58*** (0,0055)	-11,86*** (0,0056)
S*tayers*(*public*)						
Raw	9,44*** (0,0032)	9,69*** (0,0035)	9,91*** (0,0035)	7,49*** (0,0107)	11,87*** (0,0124)	10,51*** (0,0126)
Covariates	2,42*** (0,0034)	1,15*** (0,0037)	1,15*** (0,0037)	1,68*** (0,0075)	3,64*** (0,0084)	3,64*** (0,0084)
Unexplained (coeffs+threshold θ^*)	7,02*** (0,0009)	0,48** (0,0018)	1,99*** (0,0017)	4,90*** (0,0020)	1,43*** (0,0032)	2,48*** (0,0032)
Efficiency	-	8,05*** (0,0012)	6,77*** (0,0010)	-	2,73*** (0,0011)	1,53*** (0,0006)
Effects of other equations $\Delta(\overline{\hat{P}}_{g\hat{\Lambda}_g})$	-	-	-	0,91 (0,0032)	4,07*** (0,0072)	2,85*** (0,0074)
S*tayers*(*private*)						
Raw	24,21*** (0,0020)			-0,35 (0,0053)		
Covariates	-1,69*** (0,0024)			-0,71*** (0,0030)		
Unexplained (coeffs+threshold θ^*)	25,99*** (0,0018)			2,46*** (0,0024)		
Efficiency	-			-		
Effects of other equations $\Delta(\overline{\hat{P}}_{g\hat{\Lambda}_g})$	-	-	-	-2,11*** (0,0046)		

Note: Values are reported in percentage points.
* p<0.05); ** p<0.01; *** p<0.001
† Standard errors are obtained from 1000 bootstrapped replications.

7 Conclusion

This paper has attempted to analyse differences in promotion opportunities between men and women in the Egyptian labour market. To this end, we proposed a dynamic statistical-discrimination model in job promotion which accounts for the hiring stage, as well as the endogeneity of human-capital investment and quit rates. We show how the standard equilibrium in one-stage statistical discrimination models can be misleading when we consider a more realistic dynamic environment. We in particular argue that significant adversity against women at the hiring stage can affect employer's subsequent beliefs, which flip in favour of women. In other words, it may be tough for women to be hired, but once they are it is easier for them to be promoted. We test this assumption via a multivariate Simulated Maximum Likelihood regressions, which enable us to address the selection and endogeneity issues in our model. As women are supposed to hold fewer jobs in the labour force than do men, we refine our empirical analysis by considering only those workers who remain with the same employer since their first entry into the labour market. We then consider sources of inequality in hiring and promotion using a generalised residuals decomposition. Our main results are in line with the model's predictions. There is significant discrimination against women at the hiring stage which cannot be attributed to either differences in endowments or worker attachment to the labour force. However, women who overcome this initial adversity are, all else equal, at least as likely to be promoted as are men. These findings hold essentially in the private sector as things are somewhat different in the public sector. Hiring adversity against women is substantially lower in the public than in the private sector. Nevertheless, once hired, "unequal" promotion opportunities do remain in the public sector. This seems surprising since we would expect more equal promotion treatment in the public sector. These findings can be justified in the light of our theoretical model by answering the following question: Why does "belief flipping" arise in the private sector, while public-sector employers continue to hold negative beliefs about women at the promotion stage? The answer is simply that the private sector satisfies the conditions under which belief flipping will arise in the workplace. Private-sector employers face a relatively high cost from worker quitting, perhaps as a result of specific on-the-job training. In order to ensure that women have an incentive to invest in promotion and remain in the job once promoted, the employer has to propose a large wage rise on promotion. In our model, such wage profiles weaken the selection mechanism at the hiring stage, and hence require tougher hiring standards. Under these conditions, employer's beliefs flip, and women have to satisfy much lower promotion criteria. By way of contrast, the public sector is characterised by a narrower wage structure and fewer barriers to entry, which make the employer more uncertain about women's eligibility for promotion.

Our inclusion of a measure of worker labour-force attachment, here the demographic fertility index, allows us to distinguish between differences in hiring and promotion opportunities from institutional factors such as discrimination, which may not be efficient, and from workers' labour-force attachment, which can be considered as efficient. This identification represents, in our opinion, an advance in terms of the accurate measurement of adversity against women in the labour market, which is rarely addressed in empirical studies.

Last, we are aware that these results are subject to a number of limitations. To test promotions in a dynamic environment, we would ideally need to use panel data, allowing us to follow the same individuals over time. The use of cross-sectional data here prevents us from estimating a more advanced dynamic model.

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Appendix

A Proofs

Investment condition at the hiring stage:

$$\eta_1[F_u^h(\theta^{*h}) - F_q^h(\theta^{*h})] + \eta_2[1 - F_q^p(\theta^{*p})]\int_0^{\eta_2} h(\omega)d\omega + [1 - F_q^p(\theta^{*p})]\int_{\eta_2}^{\infty} \omega h(\omega)d\omega$$
$$+\eta_1 F_q^p(\theta^{*p})\int_0^{\eta_1} h(\omega)d\omega + F_q^p(\theta^{*p})\int_{\eta_1}^{\infty} \omega h(\omega)d\omega - \eta_1\int_0^{\eta_1} h(\omega)d\omega - \int_{\eta_1}^{\infty} \omega h(\omega)d\omega \geqslant c^h \quad (19)$$

$$\eta_1[F_u^h(\theta^{*h}) - F_q^h(\theta^{*h})] + \eta_2[1 - F_q^p(\theta^{*p})]H(\eta_2) + [1 - F_q^p(\theta^{*p})]\int_{\eta_2}^{\infty} \omega h(\omega)d\omega$$
$$-\eta_1[1 - F_q^p(\theta^{*p})]H(\eta_1) - [1 - F_q^p(\theta^{*p})]\int_{\eta_1}^{\infty} \omega h(\omega)d\omega \geqslant c^h \quad (20)$$

$$\eta_1[F_u^h(\theta^{*h}) - F_q^h(\theta^{*h})] + [1 - F_q^p(\theta^{*p})]\int_{\eta_1}^{\infty} H(\omega)d\omega - [1 - F_q^p(\theta^{*p})]\int_{\eta_2}^{\infty} H(\omega)d\omega \geqslant c^h \quad (21)$$

$$\eta_1[F_u^h(\theta^{*h}) - F_q^h(\theta^{*h})] + [1 - F_q^p(\theta^{*p})]\int_{\eta_1}^{\eta_2} H(\omega)d\omega \geqslant c^h \quad (22)$$

Investment condition at the promotion stage:

$$\eta_2(F_u^p(\theta^{*p}) - F_q^p(\theta^{*p}))\int_0^{\eta_2} h(\omega)d\omega + (F_u^p(\theta^{*p}) - F_q^p(\theta^{*p}))\int_{\eta_2}^{\infty} \omega h(\omega)d\omega$$
$$-\eta_1(F_u^p(\theta^{*p}) - F_q^p(\theta^{*p}))\int_0^{\eta_1} h(\omega)d\omega - (F_u^p(\theta^{*p}) - F_q^p(\theta^{*p}))\int_{\eta_1}^{\infty} \omega h(\omega)d\omega \geqslant c^p \quad (23)$$

$$(F_u^p(\theta^{*p}) - F_q^p(\theta^{*p}))\int_{\eta_1}^{\infty} H(\omega)d\omega - (F_u^p(\theta^{*p}) - F_q^p(\theta^{*p}))\int_{\eta_2}^{\infty} H(\omega)d\omega \geqslant c^p \quad (24)$$

$$(F_u^p(\theta^{*p}) - F_q^p(\theta^{*p}))\int_{\eta_1}^{\eta_2} H(\omega)d\omega \geqslant c^p \quad (25)$$

B VARIABLE DEFINITIONS

THE DEFINITION OF THE VARIABLES USED IN THE ESTIMATIONS.

Response variables:

- Hiring probability: a binary variable for the individual currently being employed, excluding employers, self-employed and unpaid individuals working for the family.
- Promotion probability: a binary variable for the worker having been promoted at least once. Those never promoted include workers who had the opportunity to be promoted but were not promoted, and those who were in jobs that do not offer promotion opportunities.
- Education: a binary variable for the individual having attained a high level of education. High education corresponds to general and vocational high-schools, post-secondary, university and above university degrees, while low education represents illiterate, literate without any diploma, elementary and middle-school degrees.
- Propensity to fertility: This is a binary variable equal to one if the women has at least one child and zero if she has no children.

Explanatory variables for the hiring equation:

- Age.
- Age-squared.
- Marital status: single, married, divorced, widowed. The omitted category is single.
- Highest attained education certificate: we have nine education levels as dummy variables: nothing (Education1), primary (Education2), preparatory (Education3), general secondary (Education4), technical secondary 3-years (Education5), technical secondary 5-years (Education6), above intermediate (Education7), university (Education8), post graduate (Education9).
- Non-labour income.
- Region: dummy variables for the region of residence. Six regions are defined: Greater Cairo (Region1), Alexandria and Suez Canal (Region2), Urban Lower (Region3), Urban Upper (Region4), Rural Lower (Region5), Rural Upper (Region6). Greater Cairo is the omitted category.
- The fertility index F_{jk}, as defined in equation ((10)): the probability that a woman of age j having k children will bear a further child within the next five years.

Explanatory variables for the promotion equation:

- Age, age-squared, marital status, region, the fertility index F_{jk}. (These variables are as defined previously)
- The number of years of schooling.

Instruments used in order to account for the endogeneity of education

- Father's highest attained education certificate: nine levels of educational certificate are defined and used as dummy variables: illiterate, read and write, primary, preparatory, general/technical secondary, above intermediate, higher institute, university, post graduate.
- Mother's highest attained education certificate (similarly defined).

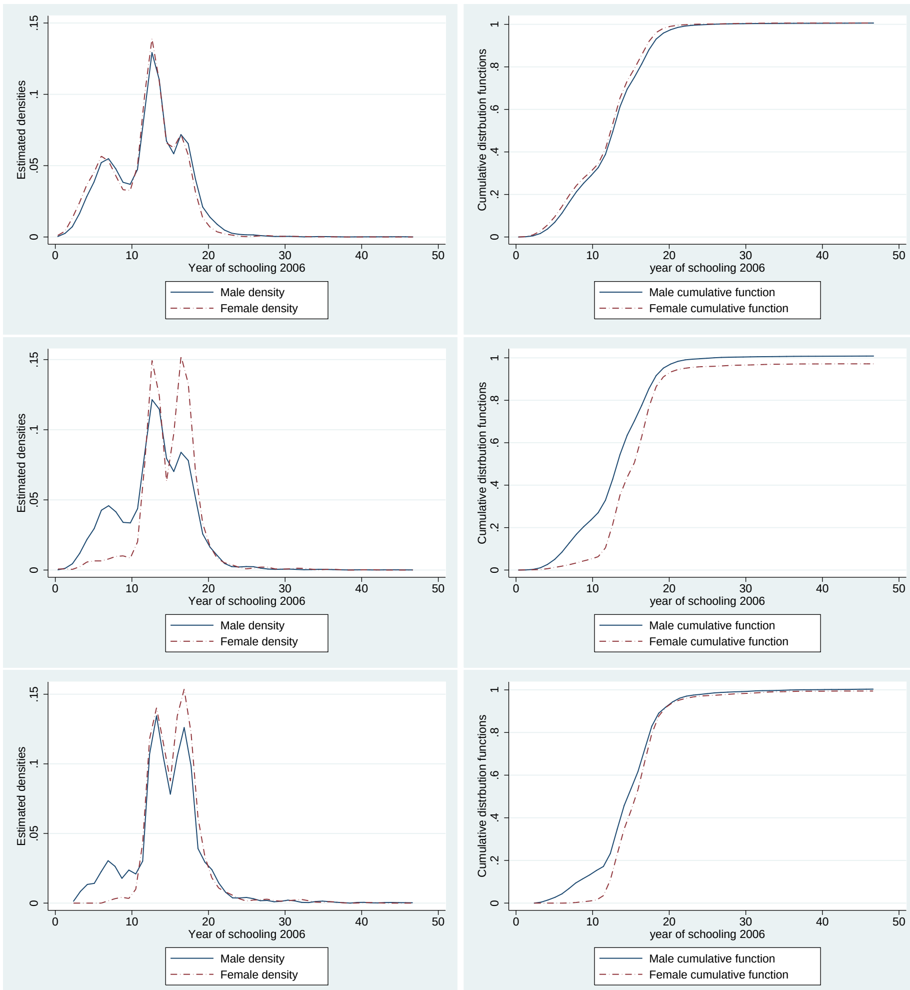
- Father's salaried status: six statuses appear as dummy variables: salaried in regular job, salaried in irregular job, employer, self employed, work for family (unwaged), no job. For individuals whose father was absent from the household, we can identify father's salaried status when the individual was 15 years old. If the individual is under 15, father's current salaried status is used, and when the father died before the individual reached 15, father's last employment is then used. Unfortunately, for individuals whose father was currently present in the household, we only have information on father's current wage status.
- Sector of father's job: seven sectors are defined: government, public enterprise, private, investment, foreign, non-profit, non-governmental organization, other including cooperatives.
- The number of siblings.
- Marital status and region of residence as defined previously.

Explanatory variables for the fertility equation:

- Age, age-squared, the number of years of schooling and region of residence.

C Figures

Figure 1: Kernel density estimates and empirical cumulative distribution functions of the number of years of schooling



Note: The frames in the left-side column of the figure compares the male and female estimated density functions for the whole sample, for wage workers and for promoted individuals. The right-side column plots, for each group, the corresponding cumulative distribution functions.

D Tables

Table 2: Amemyia's minimum Chi-squared test statistics for the overidentifying restrictions

	Male		*Female*			
			model1†		*model3*‡	
	Chi-squared	*P-value*	*Chi-squared*	*P-value*	*Chi-squared*	*P-value*
Stayers						
Hiring	11.94	0.154	30.79	0.280	14.94	0.942
Promotion	10.21	0.251	31.28	0.180	19.12	0.578
Fertility					26.39	0.387
Stayers (public)						
Hiring	2.03	0.980	21.81	0.699	9.41	0.994
Promotion	4.77	0.782	28.59	0.236	18.27	0.632
Fertility					24.11	0.513
Stayers (private)						
Hiring	8.38	0.398	22.23	0.506	14.98	0.778
Promotion	6.95	0.434	16.43	0.354	14	0.870
Fertility					26.27	0.393

Note: † Model 1 refers to the specification without fertility propensity.
‡ Model 3 takes into account fertility propensity.

Table 3: Male and female education

	Male		*Female*	
	Years of schooling	High education (%)	Years of schooling	High education (%)
All	12.19 (4.60)	64.07	11.63 (4.38)	63.75
N° Obs.	8609		7109	
Wage workers	12.92 (4.54)	69.93	14.85 (3.47)	93.54
N° Obs.	4689		1448	
Promoted	14.73 (4.58)	83.68	15.59 (3.34)	98.33
N° Obs.	1631		728	

Note: All values are weighted by the appropriate survey sampling weights.
Standard deviations in parentheses.

Table 4: Prediction of the hiring and promotion probabilities (Standard errors in parentheses)

All				
	Male	*Female*		
		Model 1†	*Model 2*‡	*Model 3*‡
Hiring probabilities				
Marginal (observed)	54.66	19.18	15.70	15.70
Marginal (predicted)	54.47 (0.165)	19.36 (0.178)	16.56 (0.191)	16.50 (0.190)
Counterfactual	-	53.84 (0.162)	58.75 (0.140)	58.75 (0.140)
Promotion probabilities				
Marginal (observed)	18.74	9.58	8.20	8.20
Marginal (predicted) $\overline{\hat{P}}_g$	18.70 (0.179)	9.25 (0.121)	7.91 (0.127)	7.94 (0.127)
Counterfactual	-	15.71 (0.160)	14.93 (0.141)	14.93 (0.141)
Conditional (observed)	34.29	49.94	52.26	52.26
Conditional (predicted)$\overline{\hat{P}}_{g\vert.}$	32.91 (0.240)	42.43 (0.263)	42.79 (0.218)	43.18 (0.220)
Effects of other equations $\overline{\hat{P}}_{g\hat{\Lambda}_g}$	9.49 (0.080)	25.19 (0.197)	24.74 (0.141)	25.08 (0.143)
N° Obs.	8609	7109	4246	4246

Note: Values are reported in percentages.
Reported values are weighted by the appropriate survey sampling weights.
† The sample in model 1 includes all women (married and non-married) between age 16 and 65.
‡ The sample in these two models includes only ever-married women between age 16 and 65.

Table 5: Prediction of the hiring and promotion probabilities (Standard errors in parentheses)

Stayers				
	Male	*Female*		
		Model 1†	*Model 2*‡	*Model 3*‡
Hiring probabilities				
Marginal (observed)	40.20	14.72	12.12	12.12
Marginal (predicted)	40.08 (0.143)	14.59 (0.145)	12.16 (0.149)	12.12 (0.148)
Counterfactual	-	41.05 (0.140)	45.80 (0.122)	45.80 (0.122)
Promotion probabilities				
Marginal (observed)	12.51	7.13	6.39	6.39
Marginal (predicted) $\overline{\hat{P}}_g$	11.85 (0.136)	6.68 (0.097)	5.89 (0.099)	5.88 (0.099)
Counterfactual	-	10.54 (0.119)	10.62 (0.109)	10.62 (0.109)
Conditional (observed)	31.11	48.45	52.72	52.72
Conditional (predicted)$\overline{\hat{P}}_{g\vert.}$	29.18 (0.252)	40.70 (0.263)	42.48 (0.220)	42.52 (0.222)
Effects of other equations $\overline{\hat{P}}_{g\hat{\Lambda}_g}$	12.52 (0.122)	26.79 (0.210)	27.38 (0.163)	27.72 (0.167)
N° Obs.	6568	6701	4045	4045

Note: Values are reported in percentages.
Reported values are weighted by the appropriate survey sampling weights.
† The sample in model 1 includes all women (married and non-married) between age 16 and 65.
‡ The sample in these two models includes only ever-married women between age 16 and 65.

Table 6: Prediction of the hiring and promotion probabilities (Standard errors in parentheses)

Stayers (public sector)

	Male	*Female*		
		Model 1†	*Model 2*‡	*Model 3*‡
Hiring probabilities				
Marginal (observed)	20.98	11.36	10.80	10.80
Marginal (predicted)	20.47 (0.191)	11.03 (0.142)	10.78 (0.151)	10.63 (0.147)
Counterfactual	-	18.05 (0.166)	19.32 (0.164)	19.32 (0.164)
Promotion probabilities				
Marginal (observed)	14.12	7.08	6.25	6.25
Marginal (predicted) $\overline{\hat{P}}_g$	13.26 (0.147)	6.63 (0.103)	5.72 (0.100)	5.73 (0.100)
Counterfactual	-	10.98 (0.124)	10.47 (0.114)	10.47 (0.114)
Conditional (observed)	67.29	62.30	57.93	57.93
Conditional (predicted) $\overline{\hat{P}}_{g\vert.}$	57.01 (0.215)	49.52 (0.238)	45.14 (0.221)	45.85 (0.224)
Effects of other equations $\overline{\hat{P}}_{g\hat{\Lambda}_g}$	31.64 (0.197)	35.57 (0.257)	36.35 (0.242)	36.41 (0.239)
N° Obs.	4990	6437	3982	3982

Note: Values are reported in percentages.
Reported values are weighted by the appropriate survey sampling weights.
† The sample in model 1 includes all women (married and non-married) between age 16 and 65.
‡ The sample in these two models includes only ever-married women between age 16 and 65.

Table 7: Prediction of the hiring and promotion probabilities (Standard errors in parentheses)

Stayers (private sector)

	Male	*Female*
		Model 1†
Hiring probabilities		
Marginal (observed)	28.92	4.26
Marginal (predicted)	28.66 (0.128)	4.46 (0.074)
Counterfactual	-	30.35 (0.135)
Promotion probabilities		
Marginal (observed)	2.17	0.36
Marginal (predicted) $\overline{\hat{P}}_g$	2.25 (0.036)	0.37 (0.007)
Counterfactual	-	2.53 (0.038)
Conditional (observed)	7.50	8.53
Conditional (predicted) $\overline{\hat{P}}_{g\vert.}$	7.03 (0.082)	7.38 (0.076)
Effects of other equations $\overline{\hat{P}}_{g\hat{\Lambda}_g}$	4.36 (0.059)	12.70 (0.147)
N° Obs.	5499	5925

Note: Values are reported in percentages.
Reported values are weighted by the appropriate survey sampling weights.
† The sample in model 1 includes all women (married and non-married) between age 16 and 65.

Table 8: Multivariate probit estimates using the maximum simulated likelihood model (All)

	Male			*Female Model*1		
Variable	**Hiring**	**Education**	**Promotion**	**Hiring**	**Education**	**Promotion**
Age	0.145***		0.251***	0.225***		0.288***
	(0.009)		(0.013)	(0.013)		(0.017)
Age-squared	-0.002***		-0.003***	-0.002***		-0.003***
	(0.0001)		(0.0002)	(0.0002)		(0.0002)
Married	0.196***	-0.211***	0.249***	-0.932***	-0.330***	-0.325***
	(0.043)	(0.035)	(0.057)	(0.056)	(0.048)	(0.076)
Divorced	-0.004	-0.403	-.125	-0.507***	-0.502***	-0.526**
	(0.204)	(0.224)	(0.229)	(0.148)	(0.133)	(0.168)
Widowed	-0.064	-0.283	-0.043	-0.772***	-1.294***	0.399***
	(0.251)	(0.240)	(0.274)	(0.113)	(0.087)	(0.124)
NLincome	-0.003e-02***			-0.001e-02**		
	(4.92e-06)			(4.57e-06)		
Education2	0.200***			0.302**		
	(0.049)			(0.096)		
Education3	0.165**			0.476***		
	(0.061)			(0.108)		
Education4	0.145			0.753***		
	(0.117)			(0.147)		
Education5	0.342***			1.027***		
	(0.067)			(0.093)		
Education6	0.625***			1.535***		
	(0.137)			(0.148)		
Education7	0.516***			1.253***		
	(0.085)			(0.107)		
Education8	0.579***			1.578***		
	(0.068)			(0.099)		
Education9	0.721***			1.835***		
	(0.190)			(0.228)		
Yrschool			0.069***			0.088***
			(0.005)			(0.007)
Region2	-0.099	-0.101	-0.366***	0.062	-0.246***	-0.257***
	(0.056)	(0.061)	(0.062)	(0.068)	(0.063)	(0.077)
Region3	-0.309***	0.051	-0.247***	0.020	0.103	0.028
	(0.054)	(0.058)	(0.060)	(0.066)	(0.061)	(0.073)
Region4	-0.295***	0.255***	-0.182***	0.107	0.082	0.052
	(0.050)	(0.056)	(0.055)	(0.062)	(0.060)	(0.069)
Region5	-0.205***	0.046	-0.239***	0.047	0.049	-0.057
	(0.048)	(0.052)	(0.053)	(0.065)	(0.056)	(0.074)
Region6	-0.505***	0.018	-0.500***	-0.302***	-0.316***	-0.455***
	(0.052)	(0.055)	(0.062)	(0.085)	(0.062)	(0.109)
CertF		Yes			Yes	
EmpstF		Yes			Yes	
SectF		Yes			Yes	
CertM		Yes			Yes	
No. siblings		-0.021***			-0.052***	
		(0.006)			(0.007)	
Constant		0.376***			0.706***	
		(0.068)			(0.078)	
ρ_{21}	-0.011			0.207***		
	(0.036)			(0.037)		
ρ_{31}	0.786***			0.902***		
	(0.014)			(0.011)		
ρ_{32}	0.117***			0.381***		
	(0.030)			(0.035)		
θ^{*h}	2.639***			5.661***		
	(0.170)			(0.245)		
θ^{*p}			7.212***			8.338***
			(0.266)			(0.347)
N° Obs.	8609			7109		
Log − likelihood	-12652.125			-7321.6021		

Notes: * p<0.05; ** p<0.01; *** p<0.001
Estimates are obtained from 100 pseudo-random draws.
Standard errors in parentheses.

Table 9: Multivariate probit estimates using the MSL model - accounting for fertility propensity (All women)

		*Model*3		
Variable	**Hiring**	**Education**	**Promotion**	**Fertility**
Age	-0.035		-0.052	0.394***
	(0.045)		(0.058)	(0.033)
Age-squared	0.001		0.002*	-0.005***
	(0.0006)		(0.0008)	(0.0005)
Married	-0.383*	0.281	0.230	
	(0.184)	(0.160)	(0.197)	
Divorced	0.057			
	(0.250)			
Widowed		-0.422	0.275	
		(0.225)	(0.261)	
NLincome	-0.002e-02*			
	(7.97e-06)			
Education2	0.352*			
	(0.158)			
Education3	0.560***			
	(0.170)			
Education4	0.809***			
	(0.236)			
Education5	1.274***			
	(0.139)			
Education6	2.023***			
	(0.230)			
Education7	1.660***			
	(0.157)			
Education8	2.137***			
	(0.151)			
Education9	2.319***			
	(0.422)			
Yrschool			0.126***	-0.038***
			(0.011)	(0.009)
Region	Yes	Yes	Yes	Yes
Findex	-1.172***		-0.973**	
	(0.331)		(0.382)	
CertF		Yes		
EmpstF		Yes		
SectF		Yes		
CertM		Yes		
No. siblings		-0.053***		
		(0.009)		
PrHiring				-0.239*
				(0.104)
Constant		0.261		-5.099***
		(0.180)		(0.484)
ρ_{21}	0.103*	(0.046)		
ρ_{31}	0.900***	(0.016)		
ρ_{41}	0.020	(0.054)		
ρ_{32}	0.301***	(0.052)		
ρ_{42}	0.042	(0.043)		
ρ_{43}	0.035	(0.051)		
θ^{*h}	1.639			
	(0.931)			
θ^{*p}			3.320**	
			(1.208)	
N° Obs.	4246			
Log − likelihood	-5493.5885			

Notes: * p<0.05; ** p<0.01; *** p<0.001
Estimates are obtained from 100 pseudo-random draws.
The numbers here are estimated coefficients (marginal effects are available from the author upon request).
Standard errors in parentheses.

Table 10: Multivariate probit estimates using the maximum simulated likelihood model (Stayers)

	Male			*Female Model1*		
Variable	**Hiring**	**Education**	**Promotion**	**Hiring**	**Education**	**Promotion**
Age	0.104***		0.235***	0.204***		0.273***
	(0.011)		(0.016)	(0.014)		(0.018)
Age-squared	-0.001***		-0.003***	-0.002***		-0.003***
	(0.0001)		(0.0002)	(0.0002)		(0.0002)
Married	0.180***	-0.227***	0.256***	-0.903***	-0.364***	-0.382***
	(0.049)	(0.039)	(0.069)	(0.060)	(0.049)	(0.079)
Divorced	-0.058	-0.436	-0.069	-0.433**	-0.623***	-0.317
	(0.252)	(0.266)	(0.277)	(0.164)	(0.140)	(0.198)
Widowed	-0.033	-0.412	-0.070	-0.709***	-1.438***	-0.457***
	(0.307)	(0.267)	(0.328)	(0.126)	(0.093)	(0.136)
NLincome	-0.002e-02**			-0.001e-02*		
	(6.32e-06)			(5.84e-06)		
Education2	0.216***			0.317**		
	(0.058)			(0.108)		
Education3	0.172*			0.552***		
	(0.072)			(0.118)		
Education4	0.064			0.832***		
	(0.128)			(0.162)		
Education5	0.137			1.087***		
	(0.076)			(0.100)		
Education6	0.583***			1.527***		
	(0.151)			(0.155)		
Education7	0.382***			1.315***		
	(0.094)			(0.116)		
Education8	0.449***			1.587***		
	(0.078)			(0.106)		
Education9	0.669**			1.940***		
	(0.213)			(0.281)		
Yrschool			0.070***			0.095***
			(0.006)			(0.008)
Region2	-0.258***	-0.165*	-0.532***	-0.034	-0.272***	-0.378***
	(0.065)	(0.072)	(0.079)	(0.076)	(0.065)	(0.091)
Region3	-0.255***	0.022	-0.318***	0.062	-0.117	0.066
	(0.059)	(0.065)	(0.071)	(0.071)	(0.063)	(0.079)
Region4	-0.390***	0.282***	-0.322***	0.082	0.081	0.044
	(0.057)	(0.065)	(0.067)	(0.068)	(0.062)	(0.076)
Region5	-0.282***	0.059	-0.383***	0.059	0.075	0.011
	(0.055)	(0.060)	(0.065)	(0.069)	(0.058)	(0.080)
Region6	-0.729***	-0.024	-0.781***	-0.356***	-0.289***	-0.456***
	(0.061)	(0.064)	(0.082)	(0.095)	(0.063)	(0.123)
CertF		Yes			Yes	
EmpstF		Yes			Yes	
SectF		Yes			Yes	
CertM		Yes			Yes	
No. siblings		-0.025***			-0.055***	
		(0.007)			(0.007)	
Constant		0.464***			-0.711***	
		(0.079)			(0.081)	
ρ_{21}	0.118**			0.160***		
	(0.040)			(0.037)		
ρ_{31}	0.866***			0.914***		
	(0.013)			(0.012)		
ρ_{32}	0.198***			0.357***		
	(0.036)			(0.039)		
θ^{*h}	1.884***			5.444***		
	(0.195)			(0.263)		
θ^{*p}			6.869***			8.179***
			(0.316)			(0.371)
N° Obs.	6568			6701		
Log − likelihood	-8987.7954			-6484.0911		

Notes: * p<0.05; ** p<0.01; *** p<0.001
Estimates are obtained from 100 pseudo-random draws.
Standard errors in parentheses.

Table 11: Multivariate probit estimates using the MSL model - accounting for fertility propensity (Stayer women)

*Model*3

Variable	**Hiring**	**Education**	**Promotion**	**Fertility**
Age	-0.060		-0.027	0.412***
	(0.048)		(0.065)	(0.034)
Age-squared	0.001*		0.001	-0.006***
	(0.0007)		(0.0009)	(0.0006)
Married	-0.420*	0.308	-0.024	
	(0.198)	(0.167)	(0.200)	
Divorced	0.062		-0.212	
	(0.267)		(0.413)	
Widowed		-0.390		
		(0.225)		
NLincome	-0.004e-02**			
	(0.001e-02)			
Education2	0.363*			
	(0.179)			
Education3	0.642***			
	(0.183)			
Education4	0.843***			
	(0.258)			
Education5	1.198***			
	(0.152)			
Education6	1.929***			
	(0.238)			
Education7	1.567***			
	(0.172)			
Education8	1.984***			
	(0.166)			
Education9	2.227***			
	(0.414)			
Yrschool			0.110***	-0.040***
			(0.012)	(0.010)
Region	Yes	Yes	Yes	Yes
Findex	-1.139**		-0.890*	
	(0.360)		(0.419)	
CertF		Yes		
EmpstF		Yes		
SectF		Yes		
CertM		Yes		
No. siblings		-0.054***		
		(0.010)		
PrHiring				-0.297**
				(0.109)
Constant		0.201		-5.284***
		(0.187)		(0.495)
ρ_{21}	0.147**	(0.046)		
ρ_{31}	0.917***	(0.016)		
ρ_{41}	0.068	(0.054)		
ρ_{32}	0.341***	(0.053)		
ρ_{42}	0.077	(0.045)		
ρ_{43}	0.098	(0.052)		
θ^{*h}	1.260			
	(1.000)			
θ^{*p}			3.467**	
			(1.343)	
N° Obs.	4045			
$Log-likelihood$	-4994.4968			

Notes: * p<0.05; ** p<0.01; *** p<0.001
Estimates are obtained from 100 pseudo-random draws.
The numbers here are estimated coefficients (marginal effects are available from the author upon request).
Standard errors in parentheses.